

## CLAIMS

What is claimed is:

1. An in-chip monitoring apparatus, comprising:
  - a test pad;
  - a transmission gate attached to a surface of a substrate and coupled to the test pad;
  - a plurality of electrical components attached to a surface of a substrate, wherein the plurality of electrical components includes a plurality of test components coupled to the transmission gate; and
  - a logic block operatively coupled to the transmission gate, the logic block to receive a code word uniquely associated with one of the plurality of test components, the logic block to control operation of the transmission gate in order to route a signal outputted by the one of the plurality of test components to the test pad.
2. An apparatus as in Claim 1, wherein the transmission gate is a multiplexer.
3. An apparatus as in Claim 1, wherein the code word has a variable bit length.

4. An apparatus as in Claim 1, wherein the code word has a bit length of four bits.
5. An apparatus as in Claim 1, further comprising:  
a code word generator to automatically generate the code word and to automatically transmit the code word to the logic block.
6. An apparatus as in Claim 5, wherein the code word generator is a computer.
7. An apparatus as in Claim 5, wherein the code word generator is incorporated as one of the plurality of electrical components on the substrate.
8. An apparatus as in Claim 1, further comprising:  
a computer coupled to the test pad the computer to process and analyze signals received from the one of the plurality of test components.
9. An apparatus as in Claim 1, wherein the test pad is attached to the surface of the substrate on which are placed a plurality of electrical components.
10. An apparatus as in Claim 1, wherein the test pad is operatively coupled to a connector attached to the substrate and wherein the test pad is operatively coupled to the transmission gate.

20250520 10:16:02

11. A method, comprising:
  - generating a first code word of variable bit length uniquely associating the first code word with one of a plurality of test components that are included within a plurality of electrical components; and
  - transmitting the first code word to a first transmission gate that is operatively coupled with the at least one of the plurality of the test components.
12. A method as in claim 8, wherein the step of uniquely associating the first code word with one of the plurality of the test components further comprises:
  - addressing the code word to the one of the plurality of test components.
13. A method of on-chip monitoring, the method comprising:
  - attaching a plurality of electrical components to a surface of a substrate;
  - connecting the plurality of electrical components with each other, the plurality of electrical components including a lesser plurality of test components;
  - attaching a plurality of test pads to the surface of the substrate, wherein the plurality of test pads is less than the plurality of test components;
  - coupling two or more of the plurality of test components to a transmission gate attached to the surface of the substrate; and
  - coupling the transmission gate to one of the test pads.

20250630.01662

14. A method as in claim 13, further comprising:  
testing the circuit.
15. A method as in Claim 14, wherein the step of testing the circuit further comprises:  
transmitting to the transmission gate a code word, the code word being uniquely associated with one of the two or more of the plurality of test components coupled to transmission gate;  
receiving a signal from the one of the two or more of the plurality of test components; and  
analyzing the signals.
16. A method of in-chip monitoring, comprising:  
attaching a plurality of test pads to the surface of a substrate, wherein plurality of test pads is less than a plurality of test components included within a plurality of electrical components attached to the surface of the substrate;  
coupling two or more of the plurality of test components to a transmission gate attached to the surface of the substrate; and  
coupling the transmission gate to a one of the test pads.
17. A method as in Claim 16, further comprising:  
testing the circuit.

18. A method as in Claim 16, further comprising:  
monitoring the circuit.

19. A method as in Claim 17, wherein the step of testing the circuit further comprises:

transmitting to the transmission gate a code word uniquely associated with one of the two or more of the plurality of test components coupled to the transmission gate;

receiving a signal from the one of the two or more of the plurality of the test components; and

analyzing the signal.

2025-01-16 10:52:06